FIELD THEORY MOTIVATED EFFECTIVE LAGRANGIAN APPROACH: TOWARDS A COMPLETE RELATIVISTIC NUCLEAR MODEL

S. K. Patra, B. K. Sharma, P. Arumugam, P. K. Sahu
Institute of Physics, Sachivalaya Marg, Bhubaneswar - 751 005, India
X. Viñas, M. Centelles, T. Sil
Departament d'Estructura i Constituents de la Matèria, Facultatde Física, Universitat de Barcelona, Diagonal 647, 08028 Barcelona, Spain

The relativistic mean field treatment of quantum hadrodynamics (QHD), has been proven to be very successful in dealing with the nuclear many-body problem. Since the model was proposed to be renormalizable, only cubic and quartic scalar self-interactions were included. More recently, inspired by the modern concepts of effective field theory (EFT) and density functional theory (DFT) for hadrons, Furnstahl, Serot and Tang [1] abandoned the idea of renormalizability and extended the relativistic mean field model (RMF) by allowing other non-linear scalar-vector, vector-vector and tensor couplings. This new formulation is termed as E-RMF. In the case of nuclear matter the RMF (with NL1 and NL3 parameters) gives too stiff equation of state (EOS) whereas the E-RMF (with G1 and G2 parameters) gives softer EOS. The recent experimental determination [2] of the EOS of dense matter favor the predictions of E-RMF (See Fig. 1). From our past [3] and present extensive E-RMF calculations, we find that the G2 set explain finite nuclei, infinite nuclear matter and neutron star in a unified way with commendable level of accuracy in all the cases. The quality of our results and the analysis of shortcomings of other relativistic models indicate that at present the E-RMF approach can be considered as a salient step towards a unified theory for finite nuclei as well as for infinite nuclear matter.

[1] R. J. Furnstahl *et al.*, Nucl. Phys. **A598**, 539 (1996); *ibid* **A615**, 441 (1997).
[2] P. Danielewicz *et al.*, Science **298**, 1592 (2002).
[3] M. Del Estal *et al.*, Nucl. Phys. **A650**, 443 (1999); Phys. Rev. C **63**, 024314 (2001); 044321 (2001).

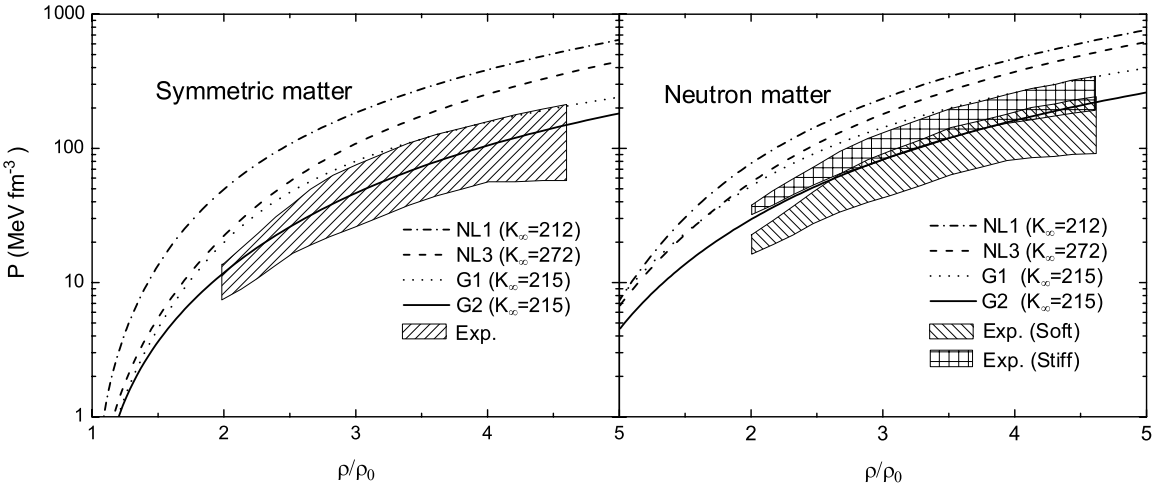

Figure 1: Zero temperature EOS for symmetric nuclear matter and neutron matter.